1185924 - R8 SDMS

FINAL

CHARACTERIZATION OF ASBESTOS CONCENTRATIONS IN BACKGROUND SOILS IN LIBBY

INITIAL RANGE-FINDING PILOT STUDY

October 18, 2010

1.0 INTRODUCTION

The Libby Asbestos Superfund Site is located in northwestern Montana near the community of Libby. A large open-pit vermiculite mine is located about 5 miles northeast of Libby. Vermiculite from this mine contains amphibole-type asbestos that includes several different mineralogical classifications, primarily winchite and richterite, with lower levels of tremolite and magnesio-riebeckite (Meeker et al. 2003). Other researchers have reported that actinolite may also be present in the ore body. The United States Environmental Protection Agency (EPA) refers to this mixture as Libby Amphibole asbestos (LA).

Historic mining, milling, and processing operations at the mine, as well as bulk transfer of mining-related materials, tailings, and waste to locations throughout the Libby Valley have resulted in releases of LA to the environment that have caused a range of adverse health effects in exposed people, including not only workers at the mine and processing facilities, but also in residents of Libby. The Site was listed on the Superfund National Priorities List (NPL) in February 2002.

One of the main sources of human exposure to LA at the Site is from contaminated outdoor soil, especially under circumstances when the soil is being actively disturbed. Measurement of LA levels released to air during a soil disturbance activity is referred to as "activity-based sampling" (ABS). EPA has performed extensive soil ABS at the Libby site, seeking to characterize airborne levels of LA that occur in association with soil disturbance activities. In some cases, these studies have detected LA fibers in ABS air samples collected in locations where the soil does not appear to be contaminated based on polarized light microscopy (PLM) analysis and visible vermiculite ranking (EPA 2010). This raises the possibility that there is some non-zero level of LA fibers in soils of the Libby Valley which are not attributable to anthropogenic releases from vermiculite mining and processing activities. If so, it is important for risk managers to gain information on the nature and magnitude of these naturally-occurring levels, since it is EPA policy not to clean up soils to a concentration lower than background (EPA 2002).

Although EPA has collected and analyzed a large number of soil samples from the Libby Valley, all of these analyses have utilized semi-quantitative and subjective analytical techniques that have relatively low sensitivity (i.e., polarized light microscopy [PLM] and field-based visual vermiculite estimates). In addition, none of the soils samples collected to date were intentionally selected to be representative of background. Consequently, reliable quantitative data on background levels of LA in Libby Valley soils are not presently available. The purpose of this pilot study is to collect and analyze soil samples that will provide an initial characterization of the range and distribution of background levels of LA and potentially other forms of asbestos in Libby Valley soils. Based on the data from this initial pilot study, additional studies may be needed to further characterize background levels of LA.

2.0 INITIAL RANGE-FINDING STUDY DESIGN

2.1 Selection of Background Locations

Selection of soil sampling locations that will be representative of background is complicated by several factors, including the following:

- Because of the complex geology and geological history of the area, soils in the Libby Valley may differ in their mineral compositions from location to location. Thus, what is background in one location may not be representative of background in all locations.
- Human activities, such as construction of buildings and roads, often results in substantial disturbance of soils, and may also involve moving soils from one location to another. To the extent that soils may differ from location to location, soils in the area of human disturbances may not necessarily be representative of background at that location.
- Historic releases of vermiculite from the mine and from other vermiculite processing and transporting facilities may have resulted in the deposition of vermiculite and LA in soils, altering their asbestos content compared to what would have been present had the mine never operated.

Based on these considerations, the following criteria are identified for use in the selection of locations for collection of background soil samples:

1. To facilitate access, all locations shall be on County, State, or Federal land
2. All locations shall be in the Libby Valley at an elevation that is not higher than the maximum level of the historic glacial lake level (i.e., 2450 feet above mean sea level)
3. All locations shall be located in an upwind or crosswind direction relative to the mine and/or known processing areas (e.g., former Export Plant)
4. There shall be no evidence of historic or recent anthropogenic activities (in the past 50-100 years) that would have resulted in substantial disturbance or mixing of soil

5. Locations shall not be within about 100 meters of any known or suspected local vermiculite emission sources (e.g., railroads, highways, vermiculite processing areas)
6. To the extent feasible, locations will be selected to accommodate possible future activity-based sampling (ABS)

Figure 1 identifies a number of areas in the Libby Valley that have been selected in accord with these criteria, and specifies a total of 20 candidate background sampling stations within these areas.

2.2 Collection of Background Samples

Each background sampling location shall be an area of approximately 300 ft^2 (e.g., 15 ft x 20 ft). A total of two 30-point composites shall be collected from each background location. Each composite shall be representative of the entire area of the sampling location. This shall be accomplished by laying out an approximately uniform grid with 30 grid nodes within the sampling area. At each grid node, two independent grab samples will be collected within about 1-2 feet of each grid node. The first grab sample shall be placed into the first composite, while the other grab sample shall be placed into the second composite. This procedure should be continued until all 30 grid nodes have been sampled[1]. Exact grid node locations and grab sample locations may be adjusted as needed to avoid local obstructions such as trees, rocks, etc.

At each grab sample location, the grab sample shall be collected using a 1-inch stainless steel coring device to cut a core that is approximately 6 inches deep. Prior to sample collection, loose organic debris (e.g., leaves, pine needles, duff) should be manually removed. Soil core samples should be collected in accord with CDM Standard Operating Procedure (SOP) CDM-LIBBY-05, Revision 2, *Soil Sample Collection at Residential and Commercial Properties* (see **Appendix A**), with the following project-specific modifications:

- Sample aliquots will be collected using a 1-inch stainless steel coring device (e.g., soil push probe).
- All sample areas will be pre-determined, and will not require a use area designation.
- The top 1 inch of each core shall be removed to minimize the potential contribution of historic deposition of airborne LA released from past mining, milling, and transporting activities. The 0-1 inch interval of each core sample for each composite shall be combined, coarsely mixed/homogenized in a stainless steel bowl in the field, and archived for possible future analysis.

[1] This sample collection approach is comparable to the procedure used for the collection of a field duplicate soil composite sample.

- The entire 1-6 inch interval of each core sample for each composite shall be combined and coarsely mixed/homogenized in a stainless steel bowl in the field. The field team should note if soil horizons are visually apparent within this depth interval, the location of these horizons and the appearance (e.g., color, grain size) of soils in each horizon.

Soil samples will be maintained under chain of custody and transported to the appropriate laboratory for preparation and analysis. See Section 4 for field collection methods and procedures.

2.3 Preparation of Soil Samples for Analysis

Soil composites from the 1-6 inch interval will be prepared for analysis in basic accord with OEAFIELDSOP-102, developed by EPA Region 10 (see **Appendix A**).

In brief, all composite soil samples received from the field shall be well mixed in the laboratory and then dried by heating in an oven at 60° C for approximately 12 hours (overnight). Following drying, soil samples shall be sieved by passing the entire composite sample through an 8-inch brass or steel sieve with 6.3 mm openings. The material passing through the 6.3 mm screen will be well-mixed and split into two halves – one half will be archived and the other half will be analyzed. A 500 gram aliquot of the material passing through the 6.3 mm screen will be sent for analysis of soil mineralogical properties (see Section 2.4). The remaining material will be further sieved through an 8-inch screen with 0.85 mm openings. A 50 gram aliquot of the material passing through the 0.85 mm screen will be sent for analysis of asbestos content by the fluidized bed technique (see Section 2.5). Any remaining material not sent for analysis will be archived.

2.4 Analysis of Soil Mineral Attributes

As noted above, an aliquot of the 6.3 mm-sieved soil for all samples collected as part of this study will be analyzed to characterize the basic mineral content of the soils. This is useful to help recognize soils that may have different geological origins, and hence may have different background levels of asbestos. Three basic analyses will be performed to characterize soils:

- Particle size distribution (percent sand, silt and clay)
- Optical petrographic analysis (optical point counting)
- X-ray Diffraction (XRD) analysis

SOPs for each analytical method will be provided by the analytical laboratory selected for analysis.

2.5 Preparation of Fluidized Bed Filters

As noted above, an aliquot of the 0.85 mm-sieved soil for all samples collected as part of this study will be prepared using the fluidized bed asbestos segregator. Three replicate fluidized bed filters will be prepared for each soil sample in basic accord with OEAFIELDSOP-102 (Rev 1.2). Each filter shall be prepared using an independent aliquot of 0.85 mm-sieved soil.

2.6 Analysis of Fluidized Bed Filters

2.6.1 Transmission Electron Microscopy (TEM)

Analytical Method

Each fluidized bed filter shall be submitted for asbestos analysis using transmission electron microscopy (TEM) in basic accord with the International Organization for Standardization (ISO) 10312 method (ISO 1995) counting protocols, and in accord with the following Libby-specific laboratory modifications: LB-000019, LB-000028, LB-000029B, LB-000030, LB-000053, LB-000066C[2], LB-000084, and LB-000085 (see **Appendix B**).

TEM Stopping and Recording Rules

All amphibole structures (including not only LA but all other asbestos types as well) that have appropriate Selective Area Electron Diffraction (SAED) patterns and Energy Dispersive X-Ray Analysis (EDXA) spectra, and meet the specified recording rules (see below), will be recorded on the Libby site-specific TEM laboratory bench sheets and electronic data deliverable (EDD) spreadsheet developed for fluidized bed data recording and electronic submittals (see **Appendix C**).

Initial Analysis (High Magnification)

Initially, the TEM microscopist will utilize a magnification of 20,000x. The microscopist will record the size (length and width), structure type, and the mineral type for all structures longer than 0.5 µm with an aspect ratio of 3:1 or higher. For each filter, count a minimum of two grid openings on each of two grids. Analysis will continue until one of the following is achieved:

1. The target analytical sensitivity (2.5E+04 g^{-1}) is achieved,
2. 25 total LA structures are observed, or

[2] Although a more recent version is available for this laboratory modification (i.e., LB-000066D), this study intentionally has elected to utilize an earlier version to ensure a higher frequency of structure photographic images.

3. An area of 1.2 mm^2 of filter has been examined (approximately 120 grid openings).

(Note: These stopping rules may be revised during the study as data are accumulated.)

When one of these criteria is achieved, complete the final grid opening and stop.

For preparation blanks, lot blanks, and laboratory blanks, count an area of 0.1 mm^2 (approximately 10 grid openings) and stop. For sand blanks, count an area of 0.25 mm^2 (approximately 25 grid openings) and stop. See Section 3 for a description of each type of blank.

Supplemental Analysis (Low Magnification)

After completing the initial examination at 20,000x magnification, if fewer than 25 phase contrast microscopy equivalent (PCME) structures have been recorded, and neither the target sensitivity nor the maximum area examined has been achieved, the TEM microscopist will switch to a lower magnification of 5,000x and continue to record only PCME structures (i.e., length > 5 µm, width ≥ 0.25 µm, aspect ratio ≥ 3:1) until one of the following is achieved:

1. The target analytical sensitivity (2.5E+04 g^{-1}) is achieved,
2. 25 PCME LA structures are observed, or
3. An area of 1.2 mm^2 of filter has been examined (approximately 120 grid openings).

When one of these criteria is achieved, complete the final grid opening and stop.

2.6.2 Phase Contrast Microscopy (PCM)

The TEM analytical laboratory may also be asked to analyze each filter by PCM in basic accord with the counting rules specified NIOSH 7400, Issue 2, and in accord with Libby-specific laboratory modification LB-000015. (Analysis by PCM will be contingent upon the results of a pilot study that is currently underway.) PCM counting rules are specified in Step 18 and Appendix B of NIOSH 7400. In brief, all structures that are longer than 5 µm and an aspect ratio (length:width) ≥ 3:1 should be counted. The analyst should examine a total of 200 fields of view (FOVs). This should yield an analytical sensitivity of about 2.0E+04 g^{-1}. Results should be recorded Libby-specific PCM EDD spreadsheet developed for fluidized bed data recording and electronic submittals (see **Appendix C**).

3.0 QUALITY CONTROL

3.1 Fluidized Bed Processing QC Samples

Sand Blank. A sand blank consists of asbestos-free quartz sand that is processed in the fluidized bed asbestos segregator. Sand blanks determine if decontamination procedures of fluidized bed equipment used for sample processing are adequate to prevent cross-contamination. Sand blanks will be processed at the beginning of the study, and thereafter at a frequency of 10% (after every 10^{th} sample processed).

Lot Blank. A lot blank is a filter cassette which has been taken from a new box of filter cassettes. Lot blanks are collected to ensure that sample filter cassettes do not have any asbestos contamination prior to their use. One blank per lot (500 cassettes) will be analyzed before the beginning of the study.

Preparation Blank. A preparation blank is a filter that is left uncovered on the bench top during processing of the soil samples with the fluidized bed asbestos segregator. It is a measure of general laboratory cleanliness. One preparation blank will be collected for each day of sample preparation of the fluidized bed filters. Preparation blanks will be analyzed initially at a frequency of 10%, this frequency may be adjusted depending upon the results.

3.2 TEM Laboratory QC Samples

Laboratory Blank. A laboratory blank for TEM is a grid that is prepared from a new, un-used filter by the laboratory and is analyzed by TEM using the same procedure as used for field samples. The purpose of the laboratory blank is to determine if there are any significant sources of contamination arising during filter preparation and analysis in the TEM laboratory. One laboratory blank will be analyzed at a frequency of 5% (1 out of every 20 analyses).

Recount Different. A "recount different" analysis is a re-examination of the original TEM grid openings by a different microscopist than who performed the initial examination. The purpose of the recount is to verify observed structure counts and characteristics to determine if there are inter-analyst differences. A recount different analysis will be performed at a frequency of 10% (1 out of every 10 analyses).

Repreparations. A repreparation by TEM is a grid that is prepared from a new aliquot of the same filter as was used to prepare the original grid. The purpose of the repreparation is to determine if analytical precision may be influenced by filter preparation methods in the TEM laboratory. A Repreparation analysis will be performed at a frequency of 5% (1 out of every 20 analyses).

3.3 PCM Laboratory QC Samples

Blind Recount. A "blind recount" analysis is a re-examination of the original PCM slide by a different microscopist than who performed the initial examination. The purpose of the recount is to assess analytical precision and determine if there are any apparent inter-analyst differences. A blind recount analysis will be performed at a frequency of 10% (1 out of every 10 analyses).

Repreparations. A repreparation by PCM is a slide that is prepared from a new aliquot of the same filter as was used to prepare the original slide. The purpose of the repreparation is to determine if analytical precision may be influenced by filter preparation methods in the PCM laboratory. A repreparation analysis will be performed at a frequency of 5% (1 out of every 20 analyses).

3.4 Acceptance Criteria and Corrective Actions

Table 1 lists the acceptance criteria and corrective actions for fluidized bed processing and TEM/PCM laboratory QC samples.

4.0 FIELD COLLECTION METHODS AND PROCEDURES

4.1 Sample Labeling and Documentation

Each soil sample will be labeled in the field with a unique sample identification (ID) number. The Sample ID labels will be affixed to both the inner and outer sample bags and the Sample ID number will be written on the outside of each plastic bag. Sample ID numbers will identify the samples collected during this sampling effort by having the following format:

BK - #####

where:

BK	=	Background soil sampling prefix
#####	=	A unique sequential five-digit number

Note: Composite samples from the 0-1 inch depth interval and the 1-6 inch depth interval will be assigned unique Sample ID numbers. The "Location ID" field will be used to allow data managers to match the paired depth interval composites. The "Parent" Sample ID field will be used to match the paired samples collected from the same 300 ft^2 sample area.

The field team will complete a project-specific Field Sample Data Sheet (FSDS) for each soil sample collected. **Appendix D** provides an example of the FSDS form for this sampling effort.

4.2 Field Logbooks

Each sampling team will also maintain a field logbook in accordance with CDM SOP #4-1, *Field Logbook Content and Control* (see **Appendix A**). The log is an accounting of activities at the collection site and will duly note problems or deviations from the governing plans. Field logbooks will be completed prior to leaving the collection site. The field logbook will provide the following information:

- Project descriptor
- Logbook number
- Date
- Activities/purpose
- Personnel onsite
- Weather
- PPE
- Serial number(s) of equipment
- Sample ID number(s)
- Sample location sketch
- Deviations from approved guidance documents

4.3 Photographic Documentation

Photographs will be collected to document sampling locations and site conditions during the sampling activities with a digital camera in accordance with CDM SOP #4-2, *Photographic Documentation of Field Activities* (see **Appendix A**), with the following project-specific modification:

- Electronic captions will be used to describe the photographs instead of maintaining photographic logs in daily logbook entries. Photograph file names will be in the following format – BKG_LocationID_mm-dd-yy.

4.4 GPS Point Collection

Global positioning system (GPS) location coordinates will be collected in accordance with Libby-Specific SOP CDM-LIBBY-09, Revision 2, *GPS Coordinate Collection and Handling* (see **Appendix A**), with the following project-specific modifications:

- Multiple GPS points should be collected at each sampling area such that it is possible to establish the boundaries of the "polygon" within which the 30-point composite samples were collected.
- In addition, a single GPS point should be collected at the approximate center of each sampling area.

To ensure proper collection of GPS data, the following criteria have been established at the site for data with accuracy to ± 1 meter:

- The operator of the GPS unit must be standing at the sample location before the data collection begins.
- Once the unit begins collection of location data, the operator must remain standing at the sample location until the minimum required data points have been collected.
- A minimum of 30 data points must be collected at each XY coordinate.
- GPS collection is completed when the position dilution of precision (PDOP) is less than 4.5.

4.5 Equipment Decontamination

Decontamination of soil sampling equipment will be conducted in accordance with CDM SOP #4-5, *Field Equipment Decontamination at Non-Radioactive Sites* (see **Appendix A**), with the following project-specific modifications:

- Section 4.0, Required Equipment - Plastic sheeting will not be used during decontamination procedures. ASTM Type II water will not be used. Rather, locally available de-ionized water will be used.
- Section 5.0, Procedures - Decontamination water will not be captured and will be discharged to the ground at the worksite.
- Section 5.3, Sampling Equipment Decontamination – Sampling equipment that has been decontaminated will not be wrapped in plastic sheeting or aluminum foil. As stated in CDM SOP 4-5, Section 5.0, all equipment will be decontaminated before and after use (i.e., rinse with locally available de-ionized water).
- Section 5.6, Waste Disposal - Decontamination water will not be captured and will not be packaged, labeled, or stored as investigation derived waste (IDW). Decontamination water will be discharged to the ground at the worksite.

Materials used in the decontamination process will be disposed of as IDW as described below.

4.6 Handling IDW

Any disposable equipment or other IDW will be handled in accordance with CDM SOP #2-2, *Guide to Handling of IDW* (see **Appendix A**), with the following project-specific modification:

- Section 5.2, Offsite Disposal – All IDW will be collected in transparent garbage bags and marked "IDW" with an indelible ink marker. These bags will be deposited into the asbestos contaminated waste stream for appropriate disposal at the local landfill.

4.7 Sample Custody and Documentation

Sample custody and documentation will follow the requirements specified in CDM SOP #1-2, *Sample Custody*, with Libby-specific modifications (see **Appendix A**), with the following clarifications:

- Section 5.1, Transfer of Custody and Shipment –
  - A chain of custody (COC) record will not be completed in the field. Initial sample custody will be documented through the collection of sample information using a hard copy FSDS (see **Appendix D**), along with a physical sample.
  - Sample labels/tags will be limited to a unique sample ID, which will be clearly indicated using pre-printed labels or hand-written on the zip-top sample bag for air samples, and both the inner and outer zip-top bag for soil samples.
  - Sampling teams will securely place a custody seal on each individual sample.

All teams will ensure that samples, while in their possession, are maintained in a secure manner to prevent tampering, damage, or loss.

The COC record is employed as physical evidence of sample custody and condition from the sample coordination team to the receiving facility. A completed COC record is required to accompany each batch of samples, regardless of whether it is hand-delivered or shipped to a processing or analytical facility.

4.8 Sample Packaging and Shipping

Samples will be packaged and shipped in accordance with CDM SOP #2-1, *Packaging and Shipping of Environmental Samples* (see **Appendix A**), with the following project-specific modifications:

- Section 1.4, Required Equipment – Vermiculite (or other absorbent material) or ice will not be used for packaging or shipping samples.

- Section 1.5, Procedures – No vermiculite or other absorbent material will be used to pack the samples. No ice will be used.

Samples will be hand-delivered, picked up by a delivery service courier, or shipped by a delivery service to the designated facility or laboratory, as applicable. The sample coordinator will package samples for transit such that they are contained and secure (i.e., will not be excessively jostled). Clean plastic totes with the lids secured or sample coolers may be used for this purpose.

5.0 DATA MANAGEMENT

5.1 Field

Original FSDSs and field logbooks will be maintained in the CDM office in Libby, Montana. Scanned copies of FSDSs and field logbooks will be provided to EPA via the Libby project eRoom after completion of the sampling program.

5.2 Fluidized Bed Processing Laboratory

The fluidized bed processing laboratory will record sample processing details in the Fluidized Bed Segregator Operating Data Sheet (provided in Appendix A of OEAFIELDSOP-102). Hard copies of all sample processing data sheets will be provided to EPA following completion of sample processing.

5.3 TEM/PCM Analytical Laboratory

The TEM/PCM analytical laboratory will utilize the Libby-specific EDD spreadsheets (see **Appendix C**) developed for fluidized bed for data recording and electronic submittals. Scanned copies of all original bench sheets will be provided to EPA as part of the laboratory job report. Electronic spreadsheets should be transmitted to EPA via email.

5.4 Soil Mineral Attributes Laboratory

The soil mineral attributes laboratory will transmit results to EPA both in hard copy and electronically using an appropriate data reporting format.

6.0 SOIL MINERAL ATTRIBUTE ANALYSIS OF OU4 SAMPLES

As discussed above, one aspect of the sampling program for this study will be the analysis of soil mineral attributes at background locations. In order to evaluate the similarity/dissimilarity of soil mineral attributes of soils at background locations to soils within OU4, a subset of soil samples

collected from OU4 as part of previous sampling efforts will also be analyzed to characterize the basic mineral content of the soils (see Section 2.4). In selecting which soil samples to analyze, the following criteria were established:

1. Located within OU4
2. Collected from an elevation below maximum level of the historic glacial lake level (i.e., 2450 feet above mean sea level)
3. Representative of surficial soil (0-6 inch interval)
4. Representative of yards (i.e., samples from gardens and flowerbeds were excluded from selection)
5. Not representative of clean fill material
6. No visible vermiculite should be observed (focus was placed on soils for which visible vermiculite information was recorded in accord with SOP CDM-LIBBY-06[3])
7. Non-detect for LA by polarized light microscopy (i.e., PLM-VE Bin A)
8. Not collected as part of ABS programs (Because ABS soils will be an important component of the risk assessment, it is more important to retain archived portions of these soils for future LA characterization.)

More than 1,100 soil samples were identified which meet the above criteria. Of these samples, a total of 20 samples were selected for the analysis of soil mineral attributes. These samples were selected to be spatially representative of OU4. **Table 2** identifies the selected soil samples. These soil samples should be retrieved from the archive location, processed in accord with the methods described in Section 2.3, and analyzed for soil mineral attributes in accord with Section 2.4. (Note: These samples will not be evaluated for asbestos using fluidized bed.)

7.0 REFERENCES

EPA. 2002. Role of Background in the CERCLA Cleanup Program. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. OSWER 9285.6-07P. April 26, 2002. http://www.epa.gov/swerrims/riskassessment/pdf/role.pdf

EPA. 2010. Activity-Based Sampling Report, Operable Unit 4, Libby, Montana, Superfund Site. U.S. Environmental Protection Agency, Region 8. June 2, 2010.

ISO. 1995. International Organization for Standardization Ambient Air. Determination of asbestos fibres – Direct-transfer transmission electron microscopy method. ISO 10312:1995(E).

[3] Implementation of this field SOP began in the fall of 2006; therefore, samples collected prior to 2007 will be excluded from selection.

Meeker GP, Bern AM, Brownfield IK, Lowers HA, Sutley SJ, Hoeffen TM, Vance JS. 2003. The Composition and Morphology of Amphiboles from the Rainy Creek Complex, Near Libby, Montana. *American Mineralogist* 88:1955-1969.

Table 1 – Acceptance Criteria and Corrective Actions for QC Samples

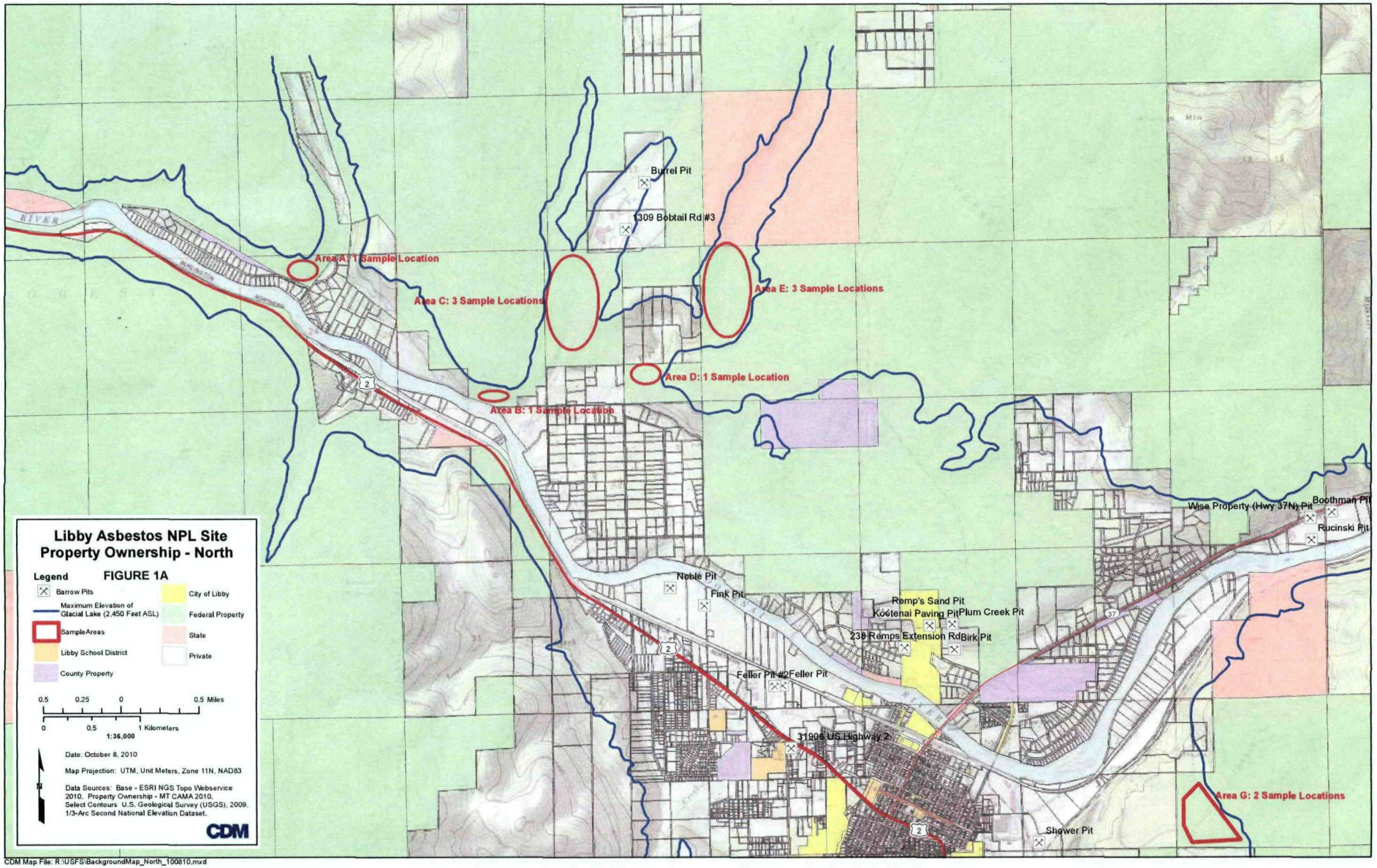
QC Sample Type	Acceptance Criteria	Corrective Action
Fluidized Bed Processing QC Samples		
Sand blank	No asbestos structures observed in an analysis of 0.25 mm^2.	The laboratory shall immediately investigate the source of the contamination and take steps to eliminate the source of contamination before processing of any samples may continue.
Lot blank	No asbestos structures observed in an analysis of 0.1 mm^2.	Discard all filter cassettes from the associated lot.
Preparation blank	No asbestos structures observed in an analysis of 0.1 mm^2.	The laboratory shall immediately investigate the source of the contamination and take steps to eliminate the source of contamination before preparation of any samples may continue.
TEM Laboratory QC Samples		
Laboratory blank	No asbestos structures observed in an analysis of 0.1 mm^2.	The laboratory shall immediately investigate the source of the contamination and take steps to eliminate the source of contamination before preparation of any samples may continue.
Recount Different	See Libby Laboratory Modification #LB-000029B	A senior laboratory analyst shall determine the basis of the discordant results, and take appropriate corrective action (e.g., re-training in counting rules, etc).
Repreparation	No more than 5% of the original-repreparation pairs are statistically different from each other at the 90% confidence interval [a].	A senior laboratory analyst shall determine the basis of the discordant results, and take appropriate corrective action (e.g., re-training in sample and filter preparation, counting rules, etc).
PCM Laboratory QC Samples		
Blind Recount	No more than 5% of the original-repreparation pairs are statistically different from each other at the 90% confidence interval [a].	A senior laboratory analyst shall determine the basis of the discordant results, and take appropriate corrective action (e.g., re-training in counting rules, etc).
Repreparation	No more than 5% of the original-repreparation pairs are statistically different from each other at the 90% confidence interval [a].	A senior laboratory analyst shall determine the basis of the discordant results, and take appropriate corrective action (e.g., re-training in sample and filter preparation, counting rules, etc).

[a] See Attachment 4 in Libby Laboratory Modification LB-000029B for details on performing this statistical comparison.

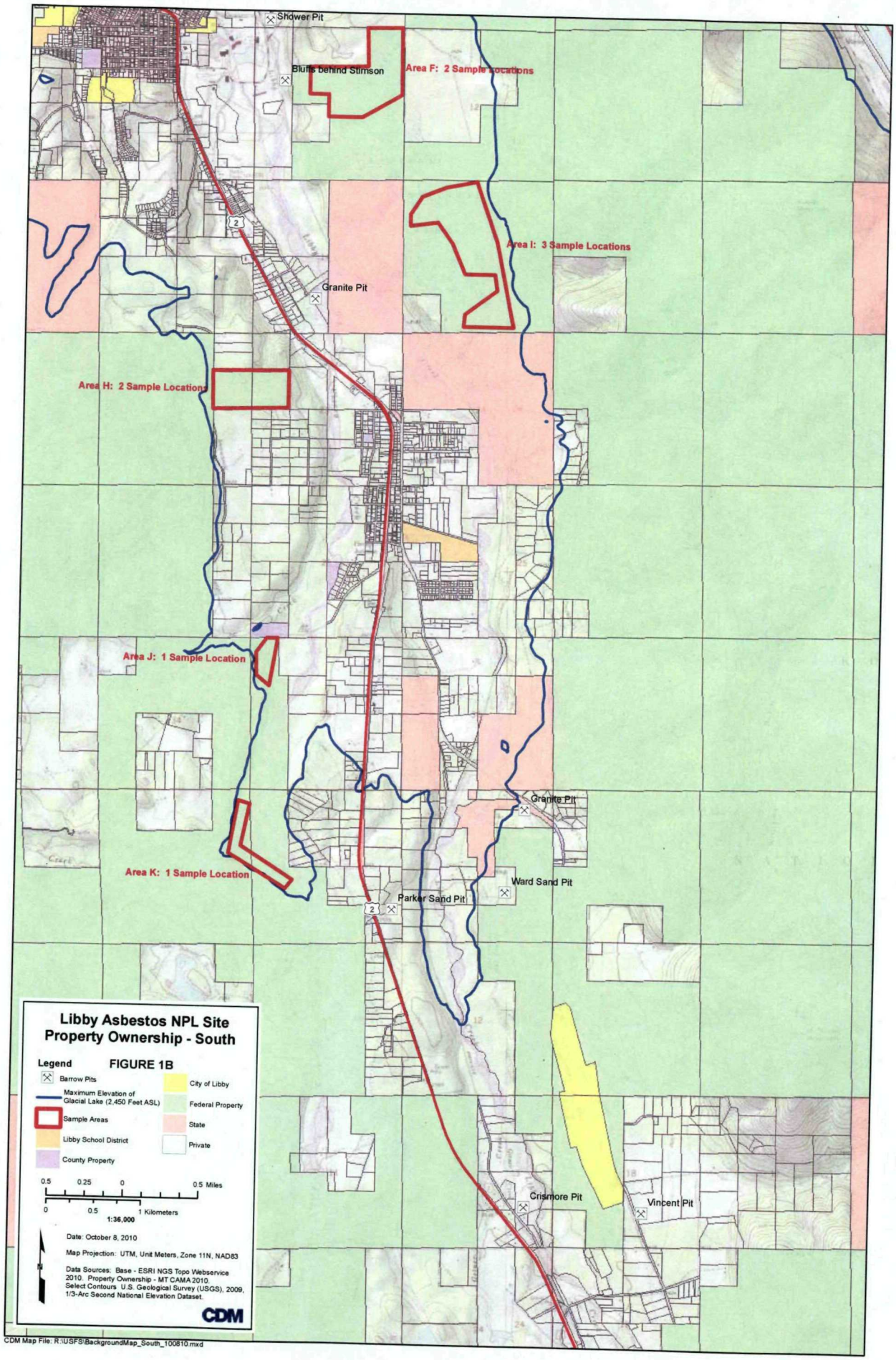
Table 2
Selected OU4 Soil Samples for Soil Mineral Attribute Analysis

Index ID	Elevation (ft)	Section of Town	Sample Location Description	Sample Date	Sample Depth (in)	Sample Comments	PLM Result	
							GRAV	VE
1D-06300	2097	Central	Back yard; NE of tiered flowerbed	5/20/2008	0-3	BD-000934; No visible	ND	ND
1D-07469	2171	South	Back yard; under covered porch	2/20/2007	0-1	Visible VCS; BD-002395		ND
1D-07904	2062	West	Front yard	4/16/2007	0-1	None; BD-002736		ND
1D-07945	2274	South	Front yard; SE corner of Farm to Market	4/18/2007	0-1	No visible LV observed. BD-003029		ND
1D-08390	2176	South	Back yard; Southeast of concrete pad	5/7/2007	0-1	BD-005299; Main auto ranch BD-001987; No Visible vermiculite		ND
1D-08648	2134	Central	Back, front, side yard; outside fence to driveway	5/14/2007	0-1	No visible; BD-004087	ND	ND
1D-08692	2145	North	Front yard	5/17/2007	0-1	BD-001361; No visible	ND	ND
1D-08915	2094	Central	Back yard; North portion of LUA	6/4/2007	0-3	No visible; BD-005319	ND	ND
1D-08964	2075	North	Back yard; S.W. of house	6/8/2007	0-3	No Visible; BD-002935		ND
1D-09561	2071	North	Side yard	7/25/2007	0-3	No visible; BD-001845	ND	ND
1D-09838	2307	South	Back yard; around garden	8/7/2007	0-3	No visible; BD-002634		ND
1D-10137	2137	North	Front yard	8/21/2007	0-3	No visible; BD-003560	ND	ND
1D-10184	2297	North	Back yard; under deck	8/14/2007	0-3	None visible; BD-001369		ND
1D-10299	2036	Central	Front yard	8/22/2007	0-3	None visible; BD-002200		ND
1D-10405	2247	South	Front yard	9/14/2007	0-3	Not visible; BD-002272		ND
1D-10497	2138	South	Front yard; E. of bldg	9/26/2007	0-3	No visible; BD-000765	ND	ND
1D-10797	2016	West	Front yard	10/15/2007	0-3	Not visible; BD-001795		ND
1D-11750	2124	North	N of tennis court	10/1/2008	0-3	BD-001363; No visible		ND
1D-11989	2326	South	Back yard	10/14/2008	0-3	BD-002986; No visible		ND
1D-12668	2365	South	Front/Side Yd; Around Stew Pond	9/11/2009	0-3	No Vermiculite Observed	ND	ND

LUA = limited use area (e.g., pasture, field) GRAV = gravimetric analysis VE = visual area estimation analysis ND = non-detect
VCS = vermiculite-containing soil LV = Libby vermiculite



CDM Map File: R:\USFS\BackgroundMap_North_100810.mxd


Shower Pit
Bluffs behind Stimson
Area F: 2 Sample Locations
Area I: 3 Sample Locations
Granite Pit
Area H: 2 Sample Locations
Area J: 1 Sample Location
Granite Pit
Area K: 1 Sample Location
Ward Sand Pit
Parker Sand Pit
Crismore Pit
Vincent Pit
Libby Asbestos NPL Site
Property Ownership - South
Legend
FIGURE 1B
Barrow Pits
Maximum Elevation of Glacial Lake (2,450 Feet ASL)
Sample Areas
Libby School District
County Property
City of Libby
Federal Property
State
Private
0.5 0.25 0 0.5 Miles
0 0.5 1 Kilometers
1:36,000
Date: October 8, 2010
Map Projection: UTM, Unit Meters, Zone 11N, NAD83
Data Sources: Base - ESRI NGS Topo Webservice 2010. Property Ownership - MT CAMA 2010. Select Contours U.S. Geological Survey (USGS), 2009, 1/3-Arc Second National Elevation Dataset.
CDM
CDM Map File: R:\USFS\BackgroundMap_South_100810.mxd